CLAIMS

1. A lithographic apparatus comprising a level sensor configured to measure a height of a wafer surface, said level sensor comprising:

a first reflector configured to direct a beam from a light source toward the wafer surface; and

a second reflector configured to direct the beam from the wafer surface to a detector,

wherein a magnitude of an apparent depression of the wafer surface due to translation of the beam at reflective surfaces of the first and second reflectors is less than thirty-five nanometers.

2. The lithographic apparatus according to claim 1, wherein a magnitude of an apparent depression of the wafer surface due to translation of the beam at reflective surfaces of the first and second reflectors is less than twenty nanometers.

3. The lithographic apparatus according to claim 1, wherein an error in the height of the wafer surface as indicated by a corresponding position of incidence of the beam at the detector is less than seventy nanometers.

4. The lithographic apparatus according to claim 1, wherein the detector is configured to indicate a height of the wafer surface based on a position of incidence of the beam.

5. The lithographic apparatus according to claim 1, wherein a sum of a translation of the beam at a surface of the first reflector, a translation of the beam at a surface of the second reflector, and a translation of the beam at the wafer surface is less than seventy-five nanometers.

6. The lithographic apparatus according to claim 1, wherein a translation of the beam at a surface of the first reflector is less than ten percent of a central wavelength of the beam.

7. The lithographic apparatus according to claim 1, wherein the first reflector includes:

a first surface configured to direct the beam toward the wafer surface; and

a second surface configured to direct the beam toward the first surface.

8. The lithographic apparatus according to claim 1, wherein the second reflector includes:

a first surface configured to direct the beam to the detector; and

a second surface configured to direct the beam toward the first surface.

9. The lithographic apparatus according to claim 1, wherein each among said first and second reflectors comprises a mirror.

10. The lithographic apparatus according to claim 9, wherein a reflective surface of at least one of said mirrors comprises gold.

11. The lithographic apparatus according to claim 9, wherein a reflective surface of at least one of said mirrors comprises a dielectric material.

12. The lithographic apparatus according to claim 9, wherein a reflective surface of each of said mirrors comprises a metal, and

wherein the reflective surface of at least one of said mirrors has a transparent coating.

13. The lithographic apparatus according to claim 12, wherein a reflective surface of at least one of said mirrors comprises at least one of silver and aluminum.

14. The lithographic apparatus according to claim 12, wherein said coating comprises at least one of aluminum oxide, magnesium fluoride, and silicon oxide.

15. A plurality of lithographic projection apparatus comprising:

a radiation system configured to provide a projection beam of radiation;

a support structure configured to support a patterning structure, the patterning structure serving to pattern the projection beam according to a desired pattern;

a substrate table configured to hold a substrate; and

a projection system configured to project the patterned beam onto a target portion of the substrate,

wherein each lithographic apparatus includes a level sensor comprising:

a first reflector positioned to direct light from a light source towards a wafer surface; and

a second reflector positioned to direct light reflected from the wafer surface to a detector,

wherein the first reflectors of the level sensors of the plurality of lithographic apparatus are substantially identical to one another, and

wherein the second reflectors of the level sensors of the plurality of lithographic apparatus are substantially identical to one another.

16. The plurality of lithographic projection apparatus according to claim 15, wherein a process dependent apparent surface depression of one of the plurality of lithographic apparatus is substantially equal to a process dependent apparent surface depression of another of the plurality of lithographic apparatus.

17. The plurality of lithographic projection apparatus according to claim 15, wherein each of the first and second reflectors of the level sensors of the plurality of lithographic apparatus comprises a mirror.

18. The plurality of lithographic apparatus according to claim 17, wherein a reflective surface of the mirror of each of at least one of the first and second reflectors comprises gold.

19. The plurality of lithographic apparatus according to claim 17, wherein a reflective surface of the mirror of each of at least one of the first and second reflectors comprises a dielectric material.

20. The plurality of lithographic projection apparatus according to claim 17, wherein each of said mirrors is metallic, and

wherein a reflective surface of the mirror of each of at least one of the first and second reflectors has a transparent coating.

21. The plurality of lithographic apparatus according to claim 20, wherein a reflective surface of the mirror of each of at least one of the first and second reflectors comprises at least one of silver and aluminum.

22. The plurality of lithographic projection apparatus according to claim 20, wherein said coating comprises at least one of aluminum oxide, magnesium fluoride, and silicon oxide.

23. A lithographic apparatus comprising a level sensor, said level sensor comprising:

a first reflector configured to direct a beam from a light source toward a wafer surface; and

a second reflector configured to direct the beam from the wafer surface to a detector,

wherein a reflective surface of the first reflector has a coating, said coating having an optical thickness of 430 nanometers +/– 60 nanometers at a central wavelength of the beam, and

wherein a reflective surface of the second reflector has a coating, said coating having an optical thickness of 430 nanometers +/– 60 nanometers at a central wavelength of the beam.

24. The lithographic apparatus according to claim 23, wherein the coating of a reflective surface of at least one of the first and second reflectors comprises aluminum oxide.

25. The lithographic apparatus according to claim 23, wherein the coating of a reflective surface of at least one of the first and second reflectors comprises at least one of aluminum oxide, magnesium fluoride, and silicon oxide.

26. The lithographic apparatus according to claim 23, wherein the coating of a reflective surface of at least one of the first and second reflectors comprises a layer of aluminum oxide having a thickness of 275 nanometers +/– 60 nanometers.

27. The lithographic apparatus according to claim 23, wherein at least one among the first and second reflectors includes a metallic mirror having a transparent coating.

28. A lithographic apparatus comprising a level sensor, said level sensor comprising:

a first reflector configured to direct a beam from a light source toward a wafer surface; and

a second reflector configured to direct the beam from the wafer surface to a detector,

wherein a reflective surface of the first reflector has a coating, and

wherein a reflective surface of the second reflector has a coating, and

wherein the optical thickness of the coating of the reflective surface of the first reflector at a central wavelength of the beam differs from the optical thickness of the coating of the reflective surface of the second reflector at a central wavelength of the beam by 205 nanometers +/– 60 nanometers.

29. The lithographic apparatus according to claim 28, wherein the coating of the reflective surface of at least one of the first and second reflectors comprises aluminum oxide.

30. The lithographic apparatus according to claim 28, wherein the coating of the reflective surface of at least one of the first and second reflectors comprises at least one of aluminum oxide, magnesium fluoride, and silicon oxide.

31. The lithographic apparatus according to claim 28, wherein the coating of the reflective surface of at least one of the first and second reflectors comprises a layer of aluminum oxide having a thickness of 220 nanometers +/– 60 nanometers.

32. The lithographic apparatus according to claim 28, wherein at least one among the first and second reflectors includes a metallic mirror having a transparent coating.

33. The lithographic apparatus according to claim 28, wherein the optical thickness of the coating of the reflective surface of one of the first and second reflectors at a central wavelength of the beam is 140 nanometers +/– 60 nanometers, and

wherein the optical thickness of the coating of the reflective surface of the other of the first and second reflectors at a central wavelength of the beam is 345 nanometers +/– 60 nanometers.

34. The lithographic apparatus according to claim 28, wherein the reflective surface of one of the first and second reflectors has a coating of aluminum oxide having a thickness of 90 nanometers +/– 60 nanometers, and

wherein the reflective surface of the other of the first and second reflectors has a coating of aluminum oxide having a thickness of 220 nanometers +/– 60 nanometers.

35. A lithographic apparatus comprising a level sensor configured to measure a height of a wafer surface, said level sensor comprising:

a first reflector configured to direct a beam from a light source toward the wafer surface; and

a second reflector configured to direct the beam from the wafer surface to a detector,

wherein a reflective surface of at least one of the first and second reflectors comprises aluminum having a coating of native oxide.

36. The lithographic apparatus according to claim 35, wherein a magnitude of an apparent depression of the wafer surface due to translation of the beam at reflective surfaces of the first and second reflectors is less than thirty-five nanometers.

37. The lithographic apparatus according to claim 35, wherein an error in the height of the wafer surface as indicated by a corresponding position of incidence of the beam at the detector is less than seventy nanometers.

38. The lithographic apparatus according to claim 35, wherein the first reflector includes:

a first surface configured to direct the beam toward the wafer surface; and

a second surface configured to direct the beam toward the first surface.

39. The lithographic apparatus according to claim 35, wherein the second reflector includes:

a first surface configured to direct the beam to the detector; and

a second surface configured to direct the beam toward the first surface.

40. A lithographic apparatus comprising a level sensor, said level sensor comprising:

a first reflector configured to direct a beam from a light source toward a wafer surface; and

a second reflector configured to direct the beam from the wafer surface to a detector,

wherein the first reflector includes a first surface configured to direct the beam toward the wafer surface and a second surface configured to direct the beam toward the first surface, and

wherein the second reflector includes a first surface configured to direct the beam to the detector and a second surface configured to direct the beam toward the first surface.

41. The lithographic apparatus according to claim 40, wherein an apparent surface depression of the first reflector is substantially zero, and

wherein an apparent surface depression of the second reflector is substantially zero.

42. The lithographic apparatus according to claim 40, wherein at least one among the first and second reflectors comprises a prism having the respective first and second surfaces.

43. The lithographic apparatus according to claim 40, wherein said prism comprises a pentaprism.

44. A method comprising:

positioning a first reflector of a level sensor of a lithographic apparatus to direct a light beam from a light source toward a surface of a wafer;

positioning a second reflector of a level sensor of a lithographic apparatus to direct the beam from the surface of the wafer to a detector; and

selecting the first and second reflectors to obtain a minimum total effective translation of the beam at the surfaces of the first and second reflectors.

45. The method according to claim 44, wherein said selecting the first and second reflectors includes selecting the first and second reflectors to incur a minimal process-dependent apparent surface depression.

46. The method according to claim 44, wherein said selecting the first and second reflectors includes selecting the first and second reflectors to obtain a magnitude of an apparent depression of the surface of the wafer due to translation of the beam at reflective surfaces of the first and second reflectors of less than thirty-five nanometers.

47. The method according to claim 44, said method further comprising:

calibrating the level sensor with respect to a wafer-processing procedure; and

applying a result of said calibrating to a height measurement obtained using a level sensor of another lithographic apparatus.

48. A lithographic method comprising:

using a first reflector of a level sensor of a lithographic apparatus to direct a light beam from a light source toward a wafer surface;

using a second reflector of a level sensor of a lithographic apparatus to direct the beam from the wafer surface to a detector; and

determining a height of the surface of the wafer based on the beam incident on the detector,

wherein a magnitude of an apparent depression of the surface of the wafer due to translation of the beam at reflective surfaces of the first and second reflectors is less than thirty-five nanometers.

49. The lithographic method according to claim 48, wherein an error in the height of the wafer surface as indicated by a corresponding position of incidence of the beam at the detector is less than seventy nanometers.

50. The lithographic method according to claim 48, wherein a total effective translation of the beam at the surfaces of the first and second reflectors is less than twenty-five nanometers.

51. The lithographic method according to claim 48, said method further comprising changing at least one of a position and an attitude of the wafer based on the determined height.

52. The lithographic method according to claim 48, said method further comprising exposing a radiation-sensitive portion of the wafer based on the determined height.